



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup>:</b> <b>G01N 33/543, 33/58, B01J 13/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/01766</b> <b>(43) International Publication Date:</b> 14 January 1999 (14.01.99)
<b>(21) International Application Number:</b> PCT/NL97/00381 <b>(22) International Filing Date:</b> 4 July 1997 (04.07.97) <b>(71) Applicant:</b> UNIVERSITEIT UTRECHT [NL/NL]; Sorbonnelaan 16, NL-3584 CA Utrecht (NL). <b>(72) Inventors:</b> BUINING, Paul, Alexander; Utrecht University, Dept. of Molecular Cell Biology, Padualaan 8, NL-3584 CH Utrecht (NL). VAN GILSWIJK, Robertus, Petrus, Maria; Leiden University, Dept. Of Cytochemistry and Cytometry, Sylvius Laboratory, Wassenaarseweg 72, NL-2333 AL Leiden (NL). HUMBEL, Bruno, Martin; Utrecht University, Dept. of Molecular Cell Biology, Padualaan 8, NL-3584 CH Utrecht (NL). LEUNISSEN, Johannes, Leonardus, Maria; Aurion, De Toltoeren 35, NL-3912 AG Rhenen (NL). VERKLEIJ, Adrianus, Johannes; Dept. of Molecular Cell Biology, Utrecht University, Padualaan 8, NL-3584 CH Utrecht (NL). PHILIPSE, Albert, Pieter; Utrecht University, Van't Hoff Laboratory for Physical and Colloid Chemistry, Padualaan 8, NL-3584 CH Utrecht (NL). RAAP, Anton, Klaas; Leiden University, Dept. of Cytochemistry and Cytometry, Sylvius Laboratory, Wassenaarseweg 72, NL-2233 AL Leiden (NL). <b>(74) Agent:</b> SMULDERS, Th., A., H., J.; Verenigde Octrooibureaux, Nieuwe Parklaan 97, NL-2587 BN The Hague (NL).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> A METAL PARTICLE, ITS PREPARATION AND USE, AND A MATERIAL OR DEVICE COMPRISING THE METAL PARTICLE  <b>(57) Abstract</b>  <p>A metal particle comprising a metal core and a silane shell, wherein said core comprises a metal selected from the group consisting of gold, silver, platinum, palladium, rhodium, ruthenium, osmium, iridium and combinations thereof, and said shell comprises a mercaptosilane residue bound to said metal core. The silane shell may be surrounded by a further shell, which comprises a silicate, titanate, zirconate, aluminate, borate or, preferably, silane residue. The residues in this further shell may be cross-linked with each other. The particle may be a colloidal particle, and its size may be 5 nm or lower, such as 0.8 to 1.5 nm. The particle may carry a covalently attached foreign molecule. A method for preparing the particle, a material or device comprising the particle embedded in a matrix or carried on a support, and various uses of the particle.</p>		

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CLAIMS

1. A metal particle comprising a metal core and a silane shell, wherein said core comprises a metal selected from the group consisting of gold, silver, platinum, palladium, rhodium, ruthenium, osmium, iridium and combinations thereof,  
5 and said shell comprises a mercaptosilane residue bound to said metal core.
2. The metal particle of claim 1, wherein said mercaptosilane residue is derived from a mercaptosilane compound of the formula  $\text{HS}-(\text{CH}_2)_m-\text{Si}(\text{OR}^1)_n\text{R}^2_{3-n}$ , wherein m and n both are  
10 integers,  $m \geq 0$ ,  $0 \leq n \leq 3$ , each  $\text{R}^1$  independent from any further  $\text{R}^1$ 's is a member of the group consisting of hydrogen, alkyl and trialkylsilyl, and each  $\text{R}^2$  independent from any further  $\text{R}^2$ 's is a member of the group consisting of alkyl, haloalkyl, phenyl and halogen.
- 15 3. The metal particle of claim 2, wherein  
---  $0 \leq m \leq 18$ , preferably  $1 \leq m \leq 6$ , most preferably  $m = 3$ ,  
---  $0 \leq n \leq 3$ , preferably  $1 \leq n \leq 3$ ,  
---  $\text{R}^1$  is hydrogen,  $\text{C}_1\text{-C}_6$  alkyl, preferably  $\text{C}_1\text{-C}_4$  alkyl, most preferably methyl or ethyl, or  $\text{C}_1\text{-C}_4$  trialkylsilyl, most  
20 preferably trimethylsilyl, and  
---  $\text{R}^2$  is  $\text{C}_1\text{-C}_{18}$  alkyl, preferably  $\text{C}_1\text{-C}_6$  alkyl, halo( $\text{C}_1\text{-C}_{18}$ )-alkyl, preferably halo( $\text{C}_1\text{-C}_6$ )alkyl, phenyl, or halogen, wherein halo(gen) is selected from the group consisting of F, Cl, Br and I.
- 25 4. The metal particle of any one of claims 1 to 3, which has a size of 5 nm or lower, preferably a size in the range of from about 0.8 nm to about 1.5 nm.
5. The metal particle of any one of claims 1 to 4, wherein mercaptosilane residues in said shell are cross-linked with  
30 each other.
6. The metal particle of any one of claims 1 to 5, wherein said silane shell is surrounded by a further shell, said